Quorum

Gary Koob

Quorum Goal

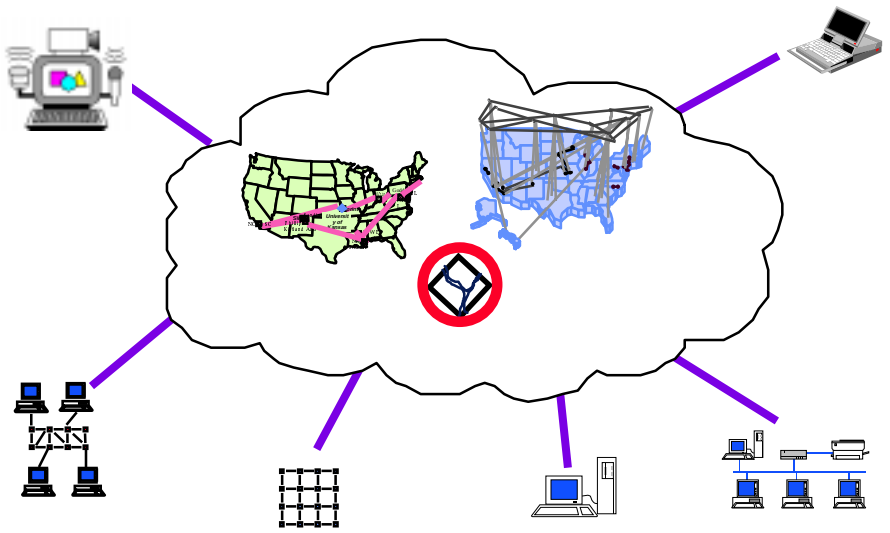
Deliver Assured Dynamic Response to Mission-Critical Applications in the Presence of Mixed Workloads

Command & Control

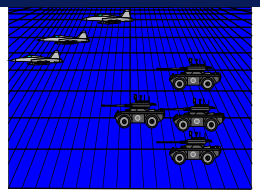
Soft Real-Time

Combat Control

Hard Real-Time

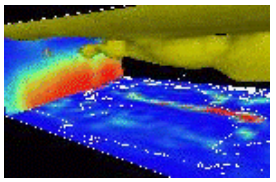


Modeling & Simulation



Mixed workload

Metacomputing

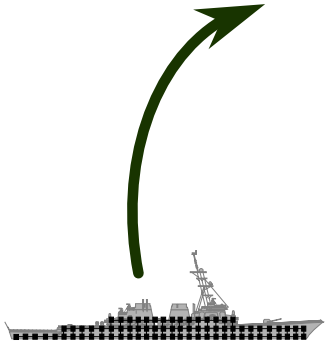


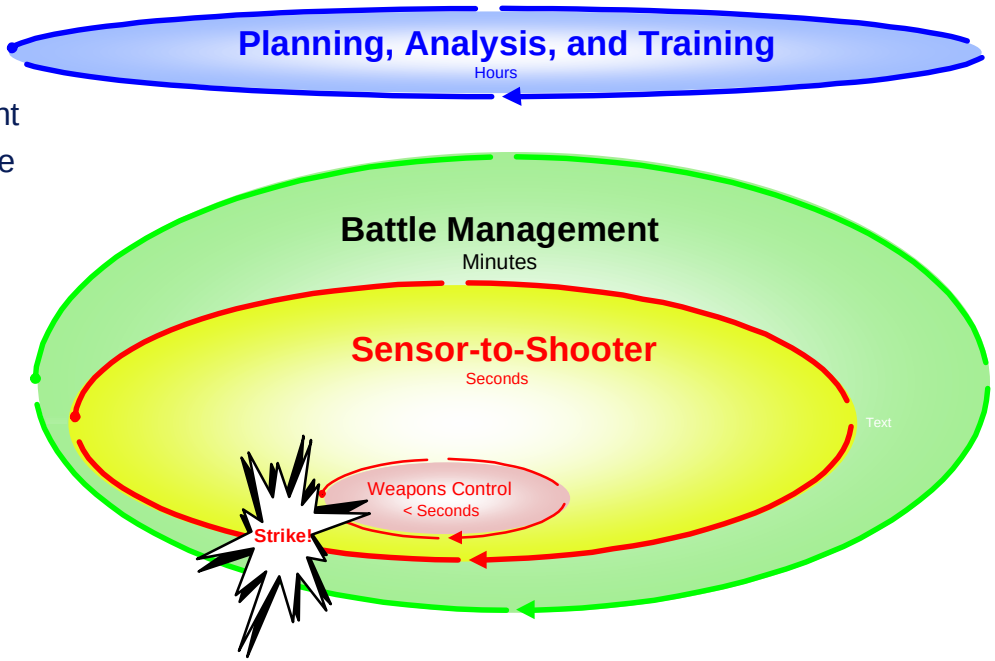
High Performance

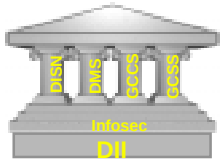
Why Mixed Workloads?

Convergence of Warfighting Domains Requires Coordination Across Multiple Time Scales

- Cooperative Engagement
- Common Tactical Picture

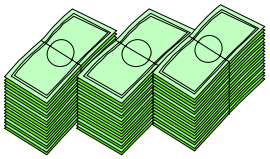


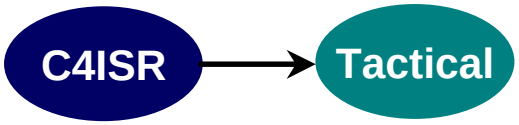


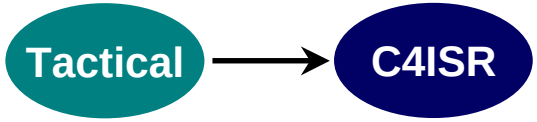


- Integrated Force Mgmt
- Battlespace Awareness

Why Mixed Workload?



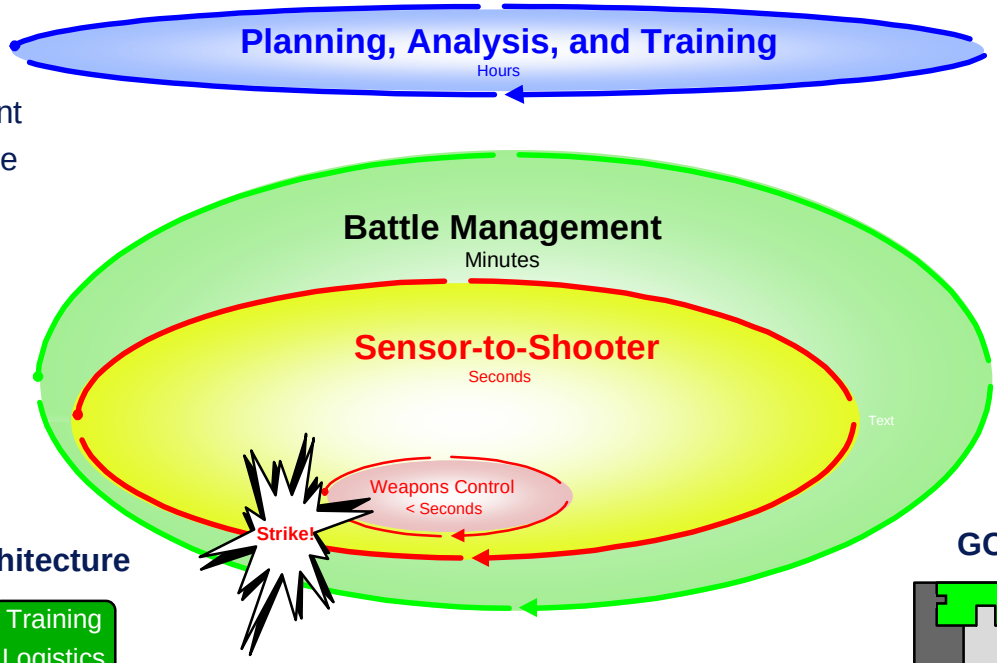




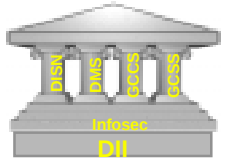
- **Affordability:**
  - Applications with different characteristics must share common computing base
- **Rapid Response:**
  - Shrinking decision cycles demand tight coupling of C4ISR and Tactical Combat Control systems
- **Battlespace Awareness:**
  - Making real-time track data accessible to C4ISR requires tactical system support for network protocols, object brokers, applications, etc. for interoperability

Impact: "Special purpose OS" must now support general purpose software

Quorum Bridges the Tactical-C4ISR Gap

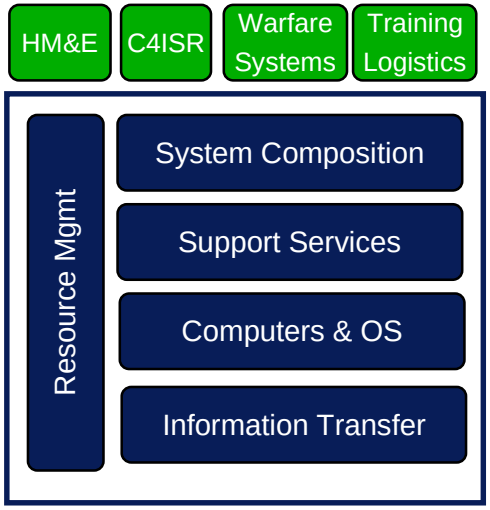


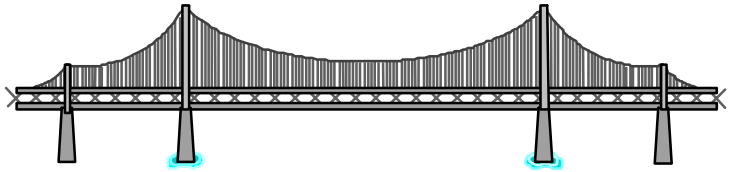
- Cooperative Engagement
- Common Tactical Picture



- Integrated Force Mgmt
- Battlespace Awareness

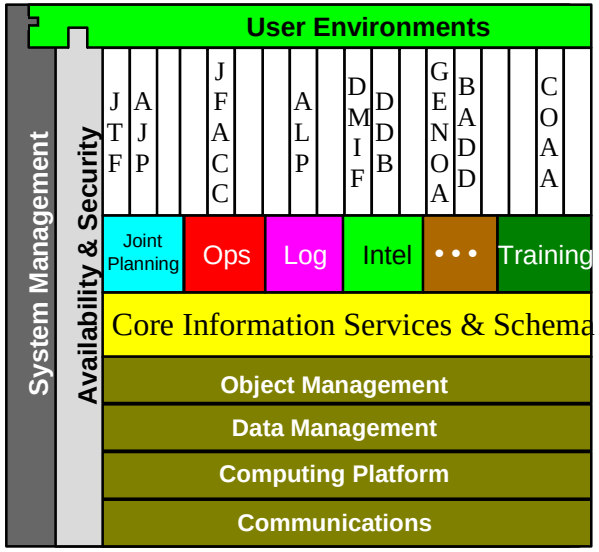
AdCon-21 Notional Architecture



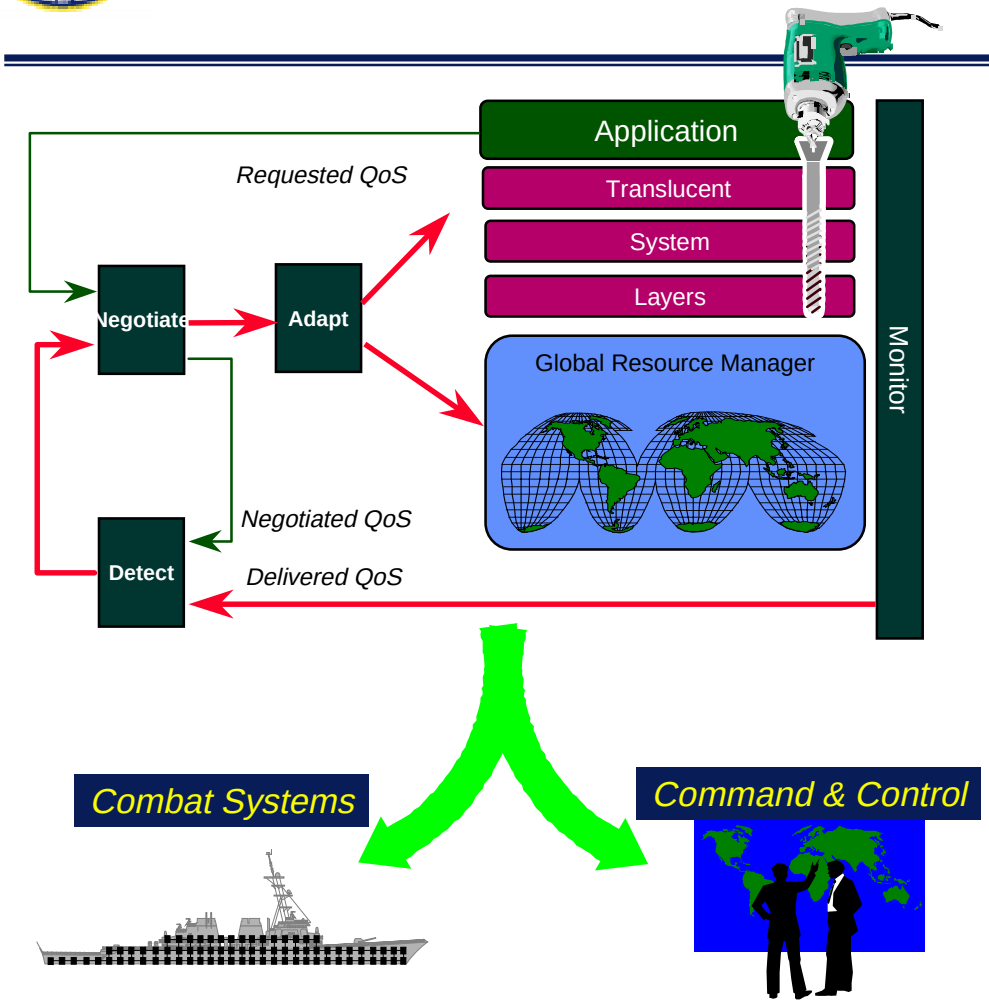


Quorum QoS-Based Technologies can bridge this gap

GCCS-LES Mid-Term Architecture



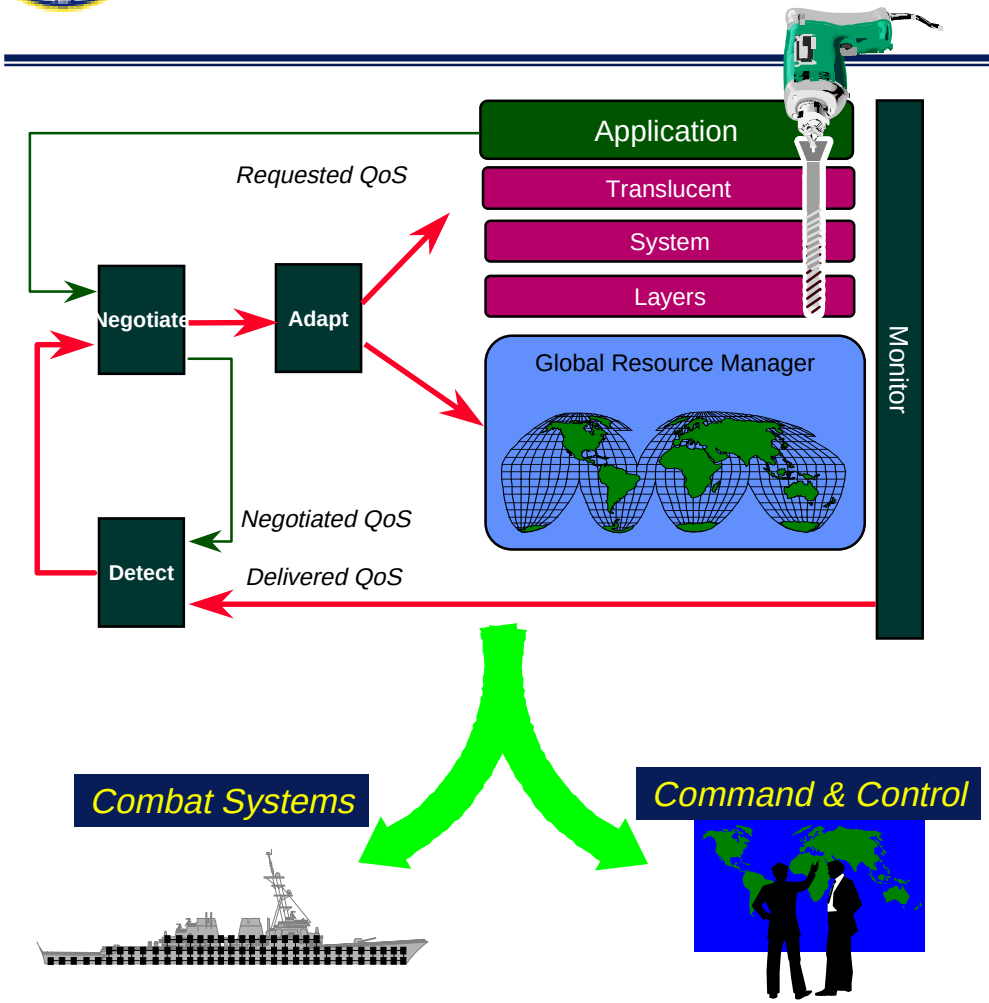
Quorum Program



- **Feedback-Based Arch**
- **Translucent Middleware**
- **Global Resource Manager**
- **Integration**

Quorum Goal: Deliver Assured Dynamic Response to Mission-Critical Applications in the Presence of Mixed Workloads

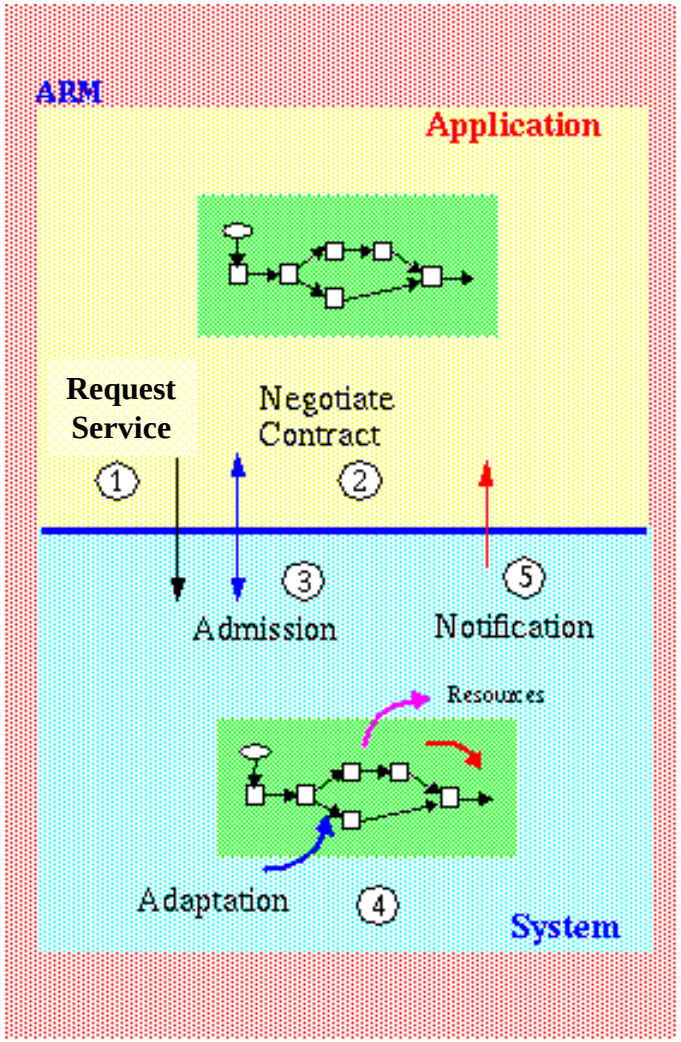
Quorum Program



- **Feedback-Based Arch**
  - Negotiated "contracts"
  - Dynamic adaptation
  - Feedback control
- Translucent Middleware
- Global Resource Manager
- Integration

Quorum Goal: Deliver Assured Dynamic Response to Mission-Critical Applications in the Presence of Mixed Workloads

Negotiated Contracts



① Application Requests Service

② Negotiation

- Applications negotiate service specifying acceptable operating region

③ Admission Control

- Application is admitted only if sufficient resources are available within region
- Prevents overloading
- Guarantees real-time tasks

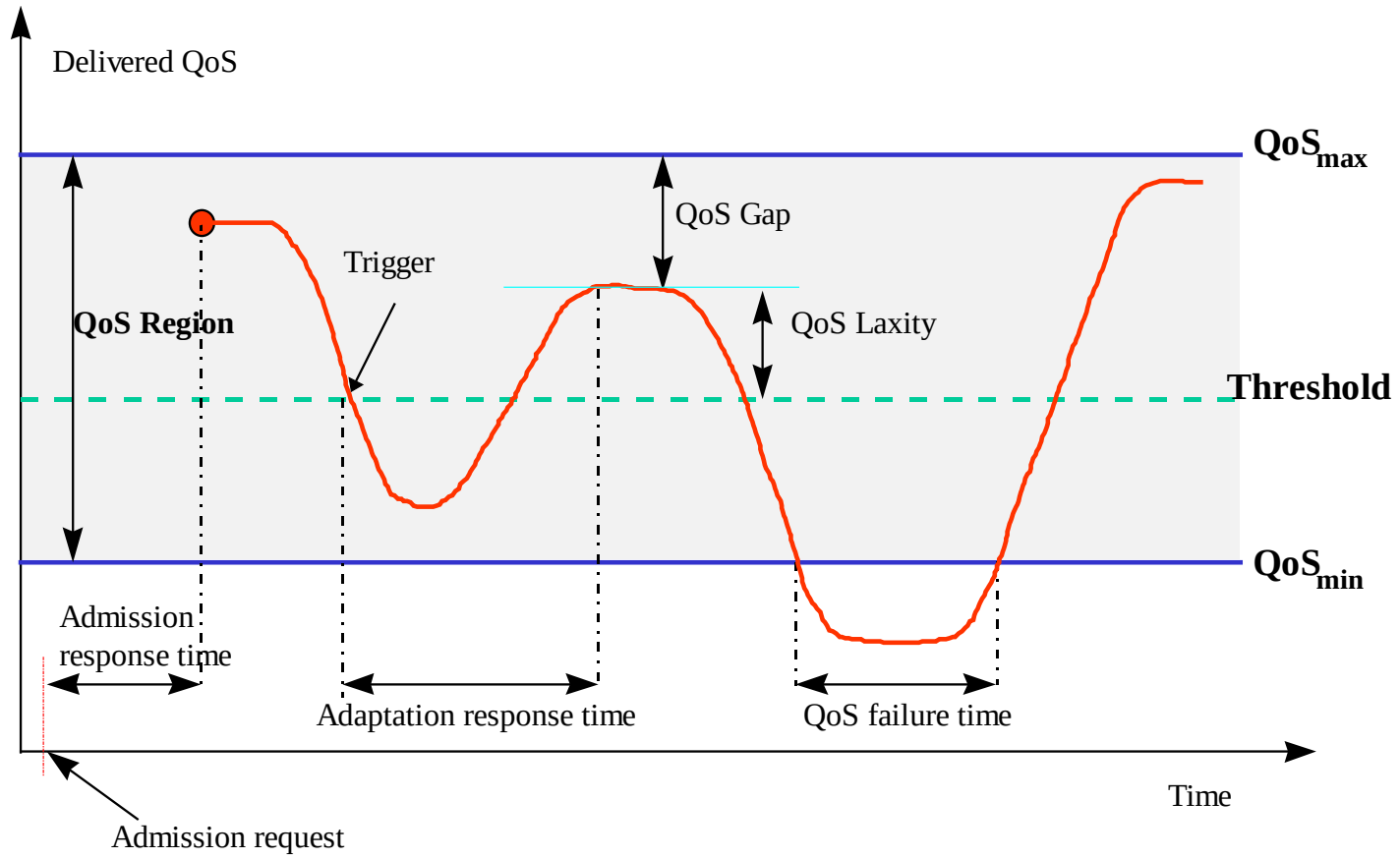
④ Adaptation

- System adapts to maintain desired region under workload, resource fluctuations

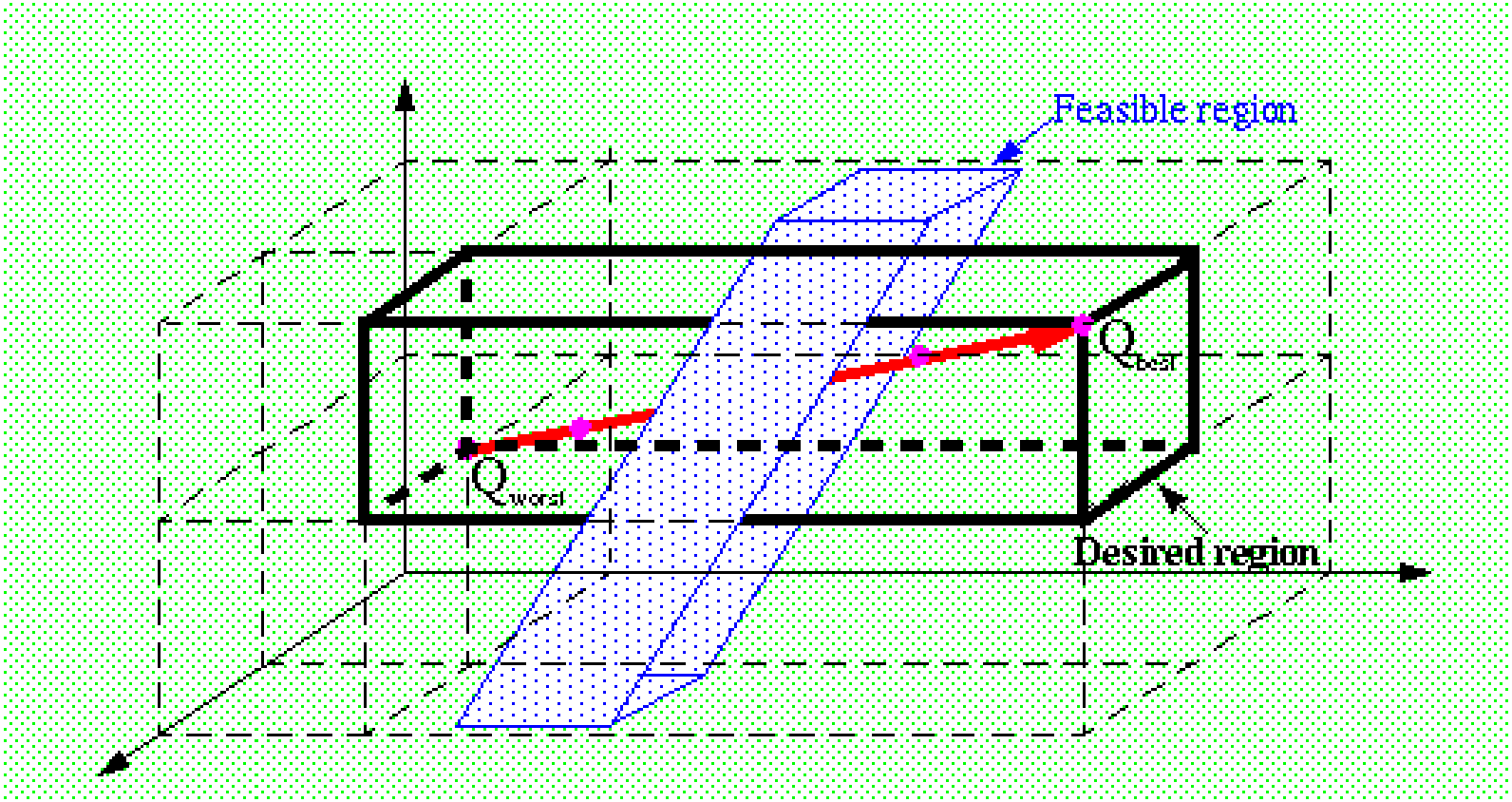
⑤ Notification

- If desired region cannot be maintained, application is notified, may renegotiate

Quality-of-Service Regions

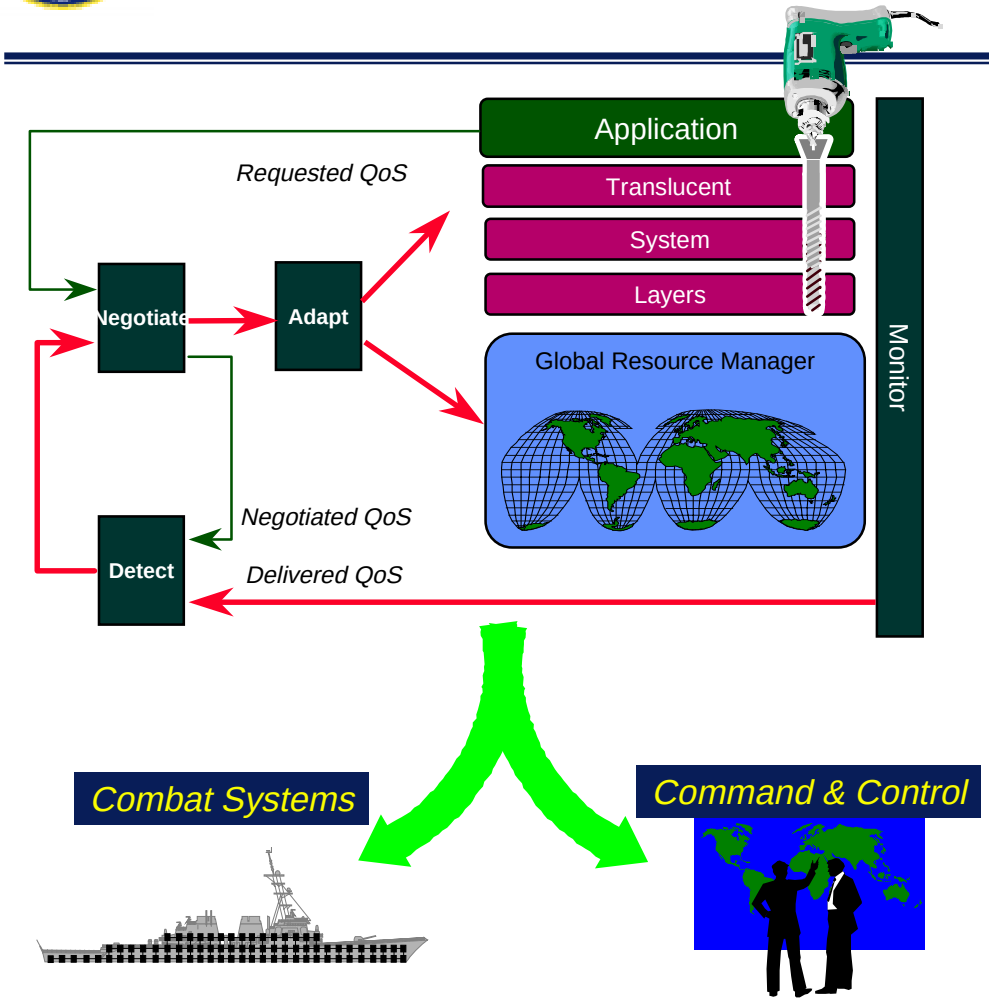


Dynamic Adaptation



- **If desired region cannot be maintained:**
  - Contract may authorize automatic transition to another feasible region (with notification), or
  - Renegotiate with application

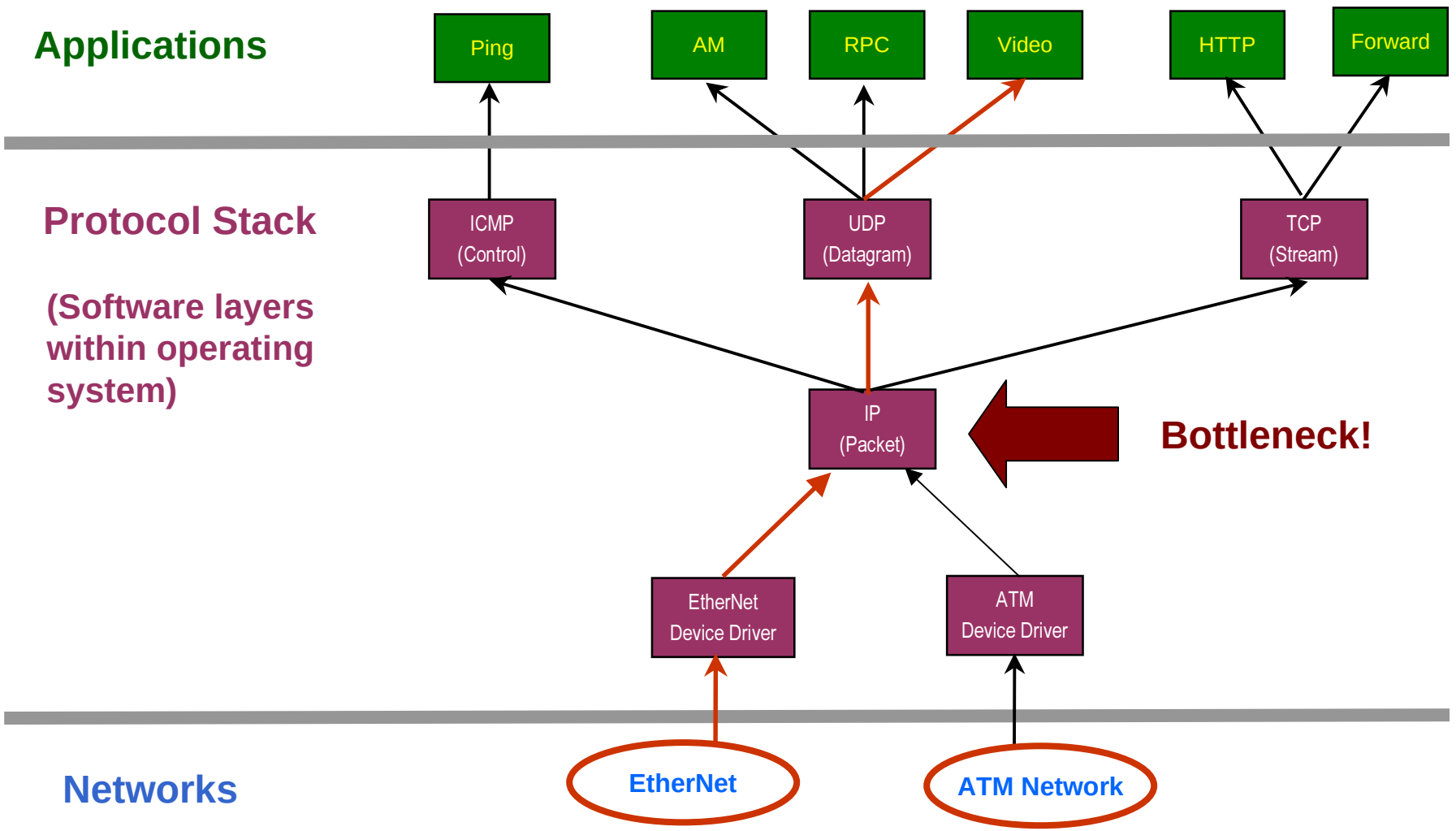
Quorum Program



- Feedback-Based Arch
- **Translucent Middleware**
  - Constraint propagation
  - Cross-layer specialization
  - Drill-down technologies
- Global Resource Manager
- Integration

Quorum Goal: Deliver Assured Dynamic Response to Mission-Critical Applications in the Presence of Mixed Workloads

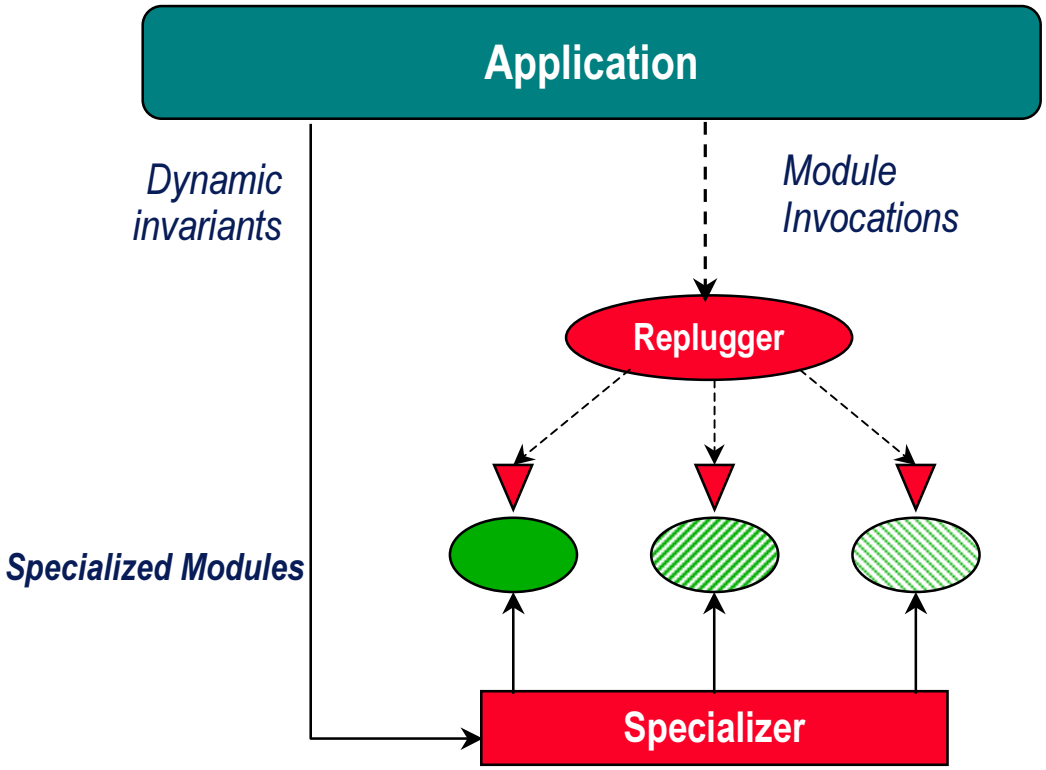
Constraint Propagation: Why?
Example: Network Protocol Stack



Constraint Propagation: Sample Approach

Specialization

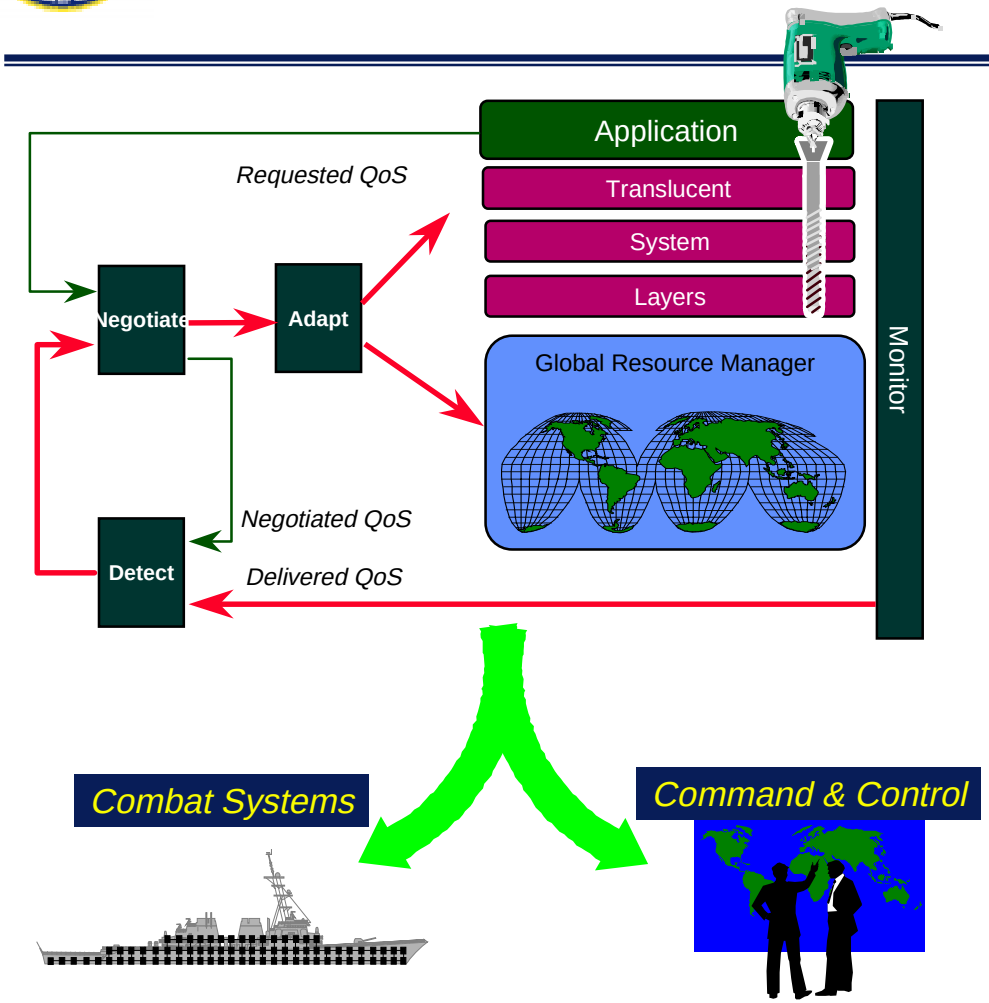
Specialization Tools Dynamically Optimize Paths Through System Code to Satisfy QoS Constraints



Replugger dynamically invokes correct variant ; manages concurrency

Specializer dynamically generates specialized variants of critical system functions

Quorum Program



- Feedback-Based Arch
- Translucent Middleware
- **Global Resource Manager**
  - Dynamic discovery
  - Path-based allocation
- Integration

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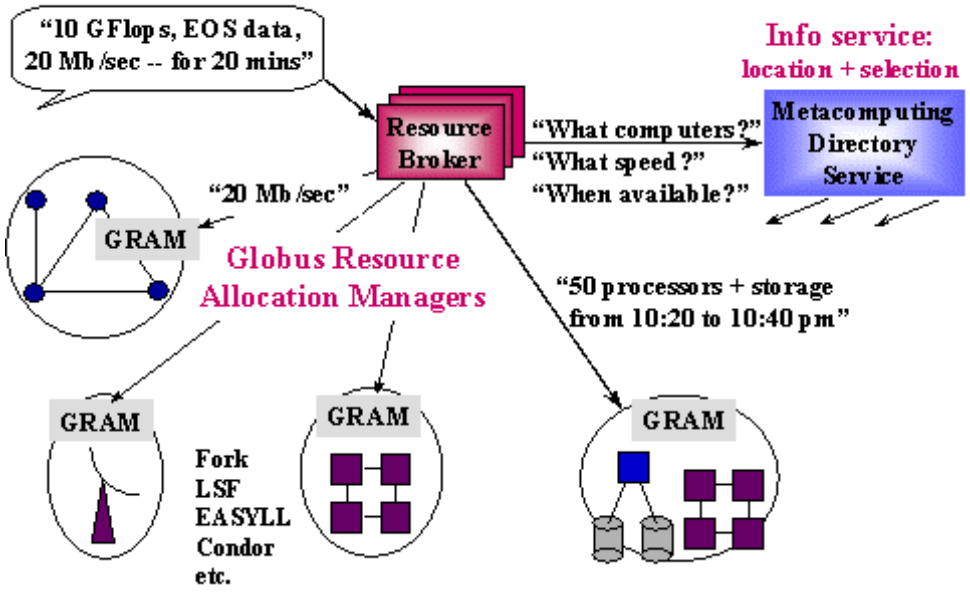
Global Resource Management
Example: Synthetic Forces Simulation

1997 GII Award

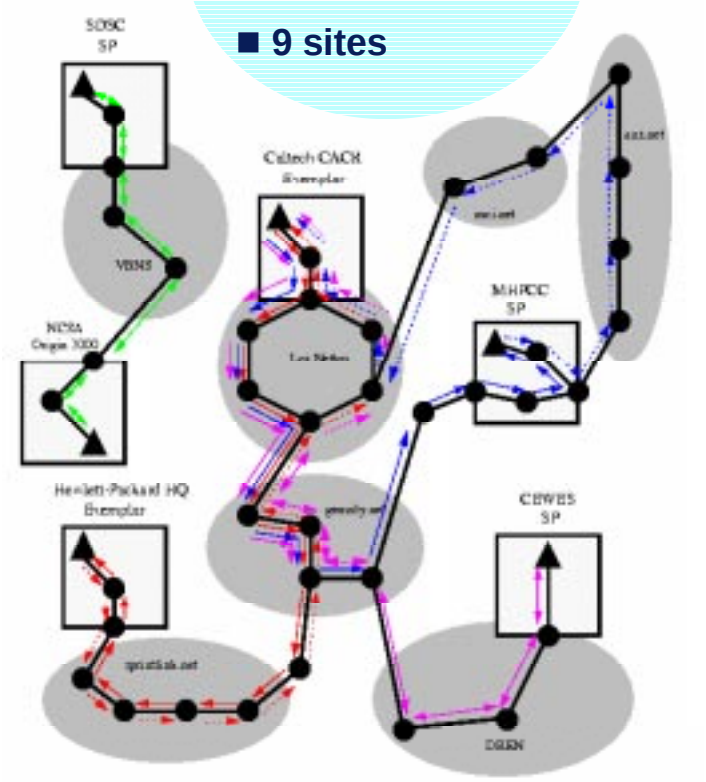
The Globus Project
(USC ISI)



- Directory Service collects, disseminates up-to-date resource status info
- Resource Broker translates requests
- Coordinates allocation across sites

SF-Express Demo
Record Set at TARA 98

- 100,000 Entities
- 1386 processors
- 9 sites

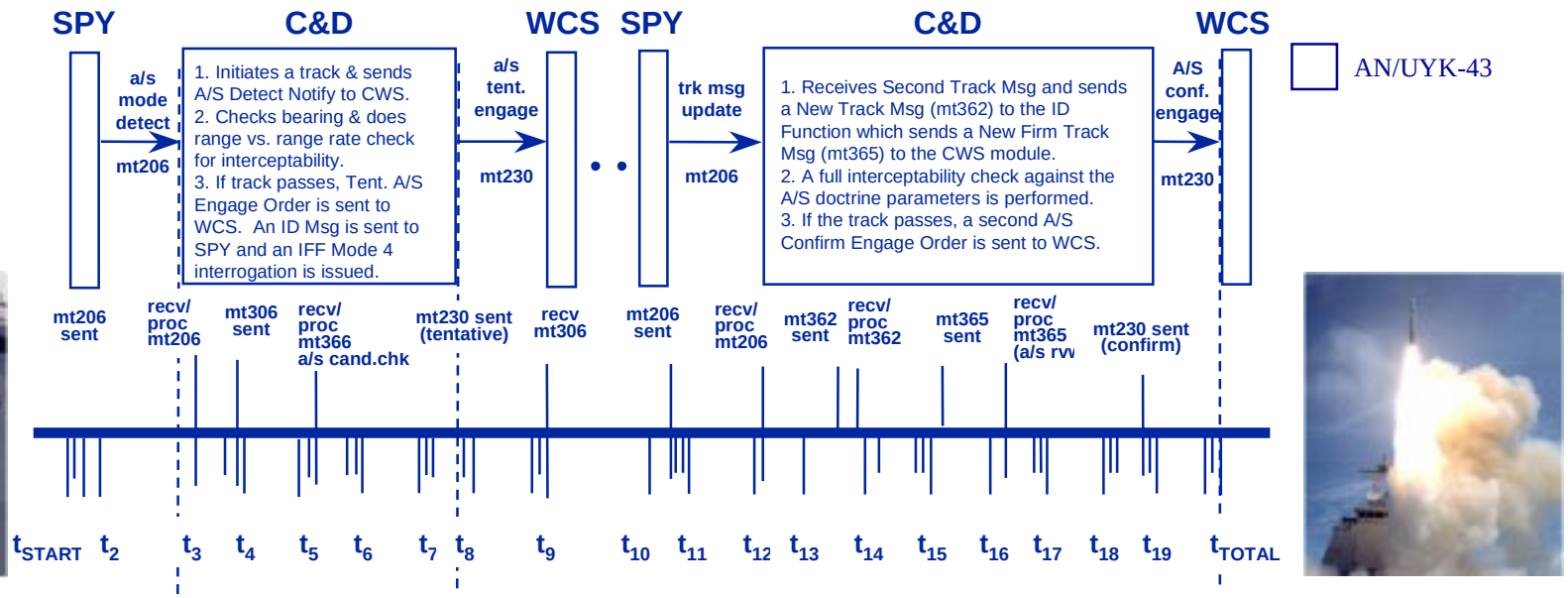


Quorum Goes to Sea

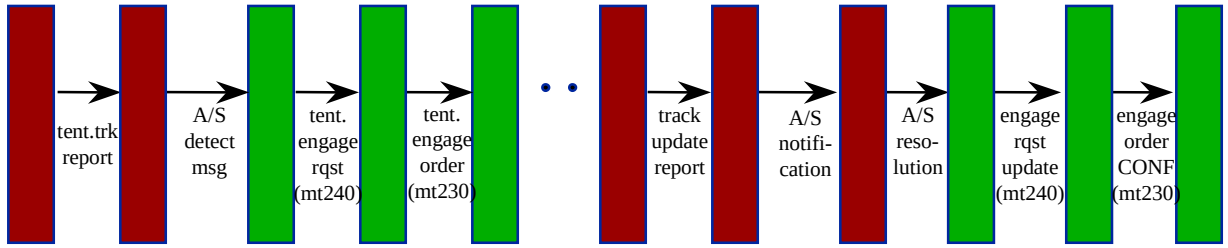
Transition Target: DD-21 Land Attack Destroyer

Why DD-21 Needs Assured Response: SPY Radar Auto-Special Time-Line

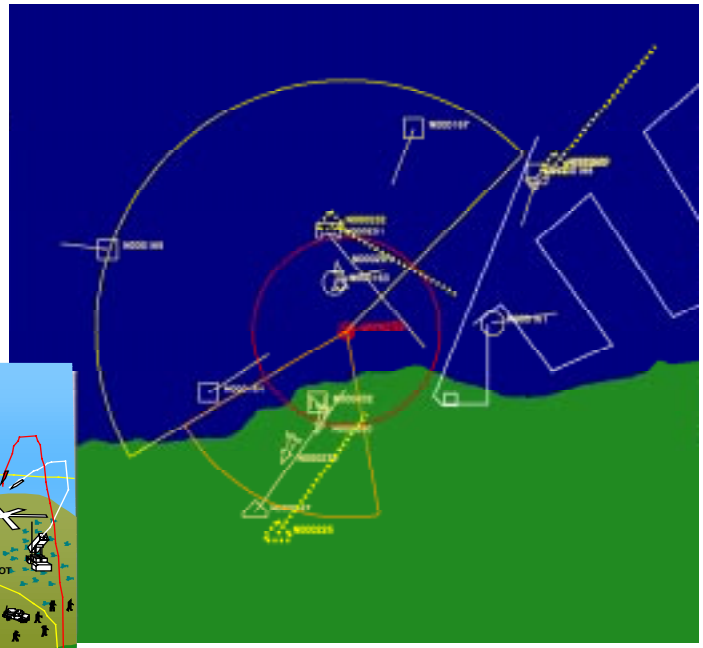
CURRENT AWS

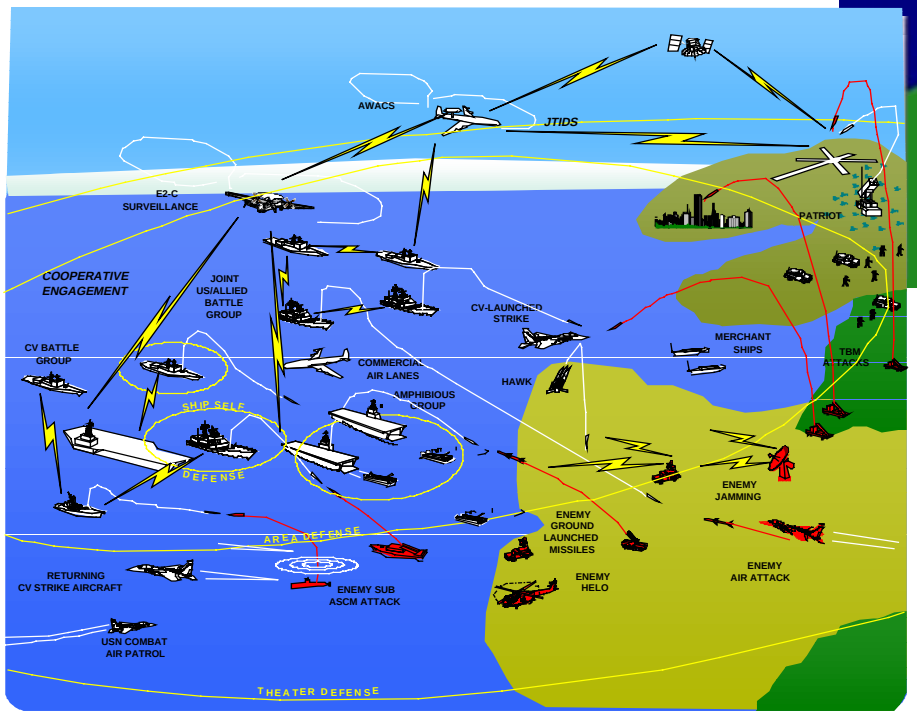


AdCon-21

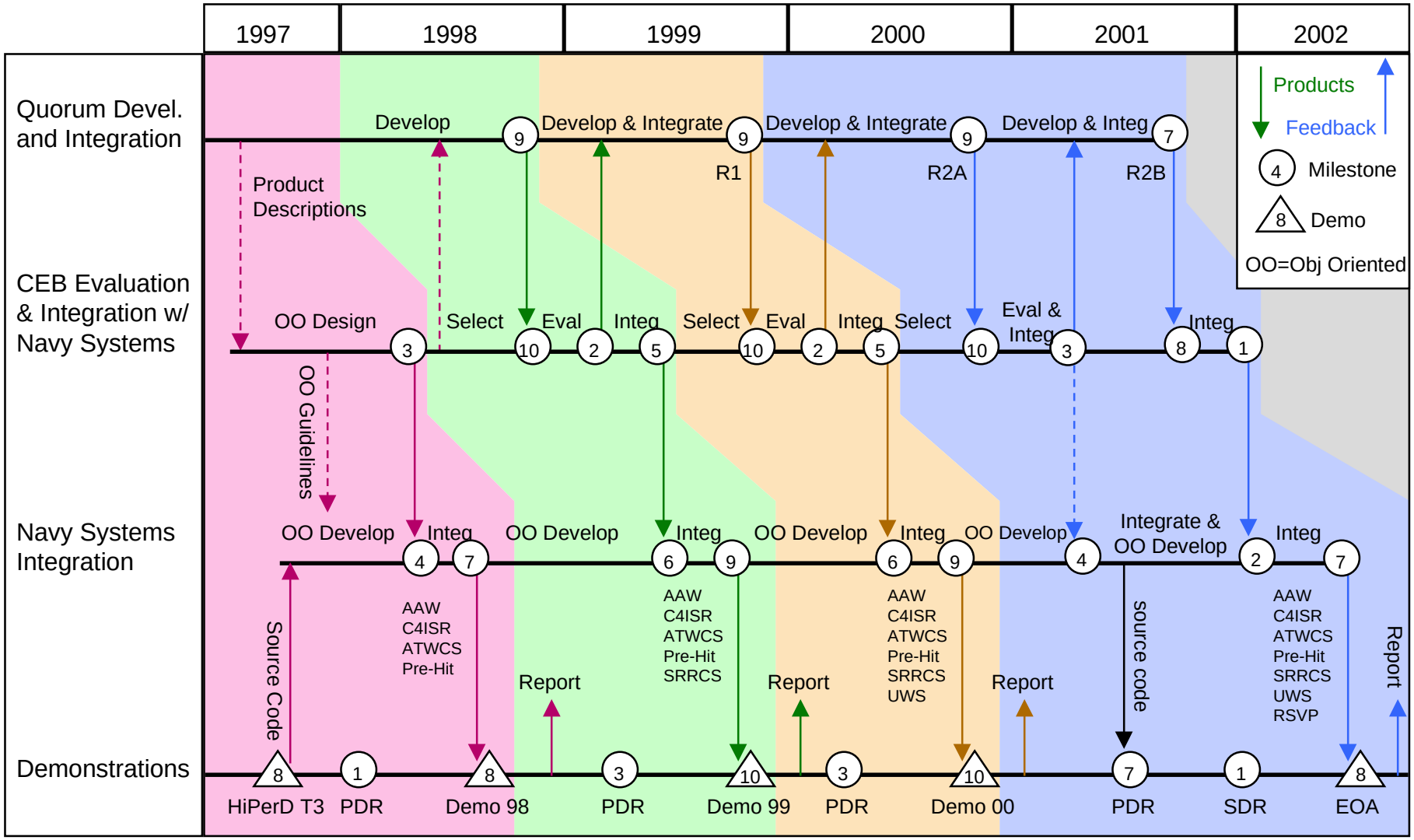


Why DD-21 Needs Mixed Workloads:
Integration of Combat & C4ISR in Littoral Battlespace

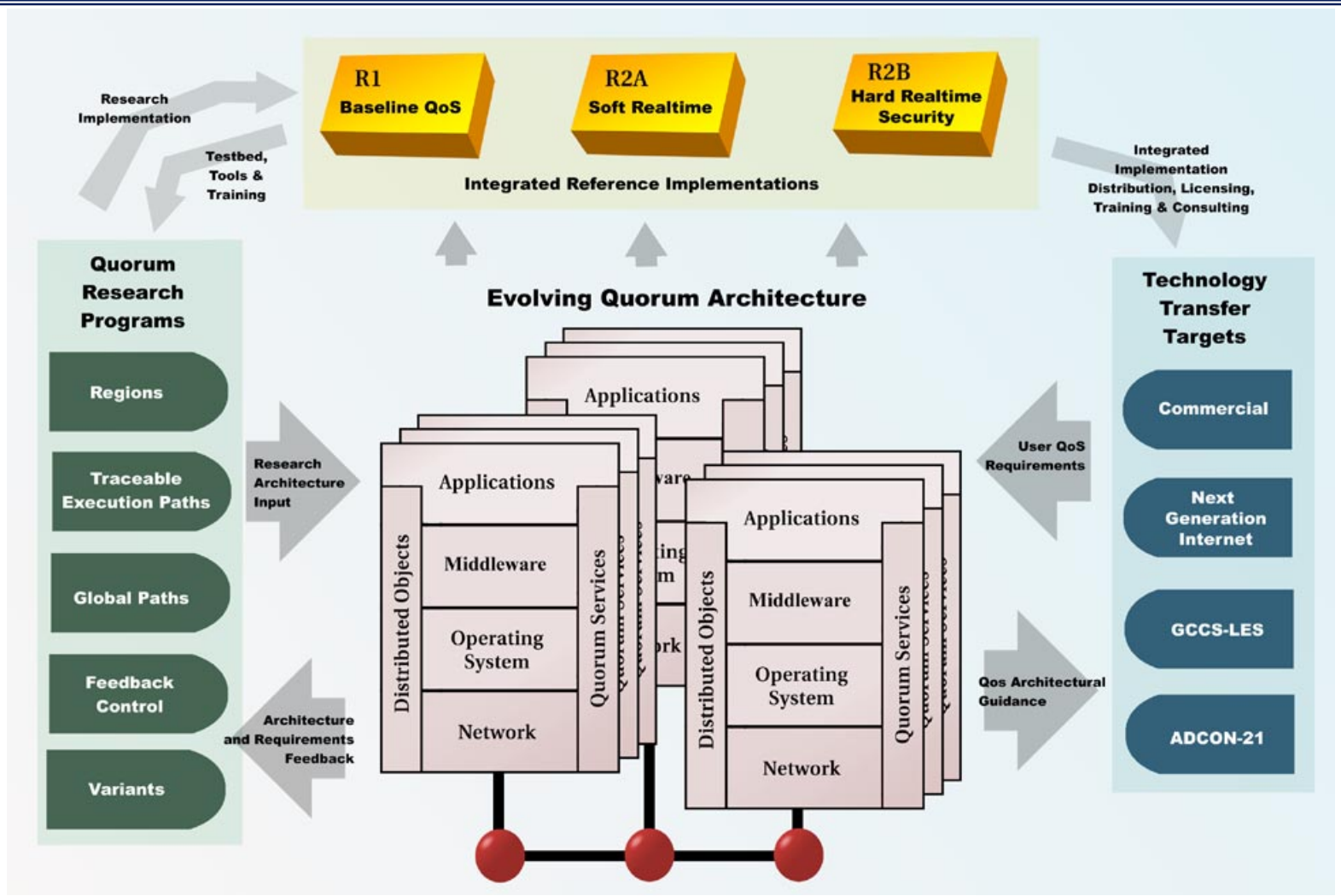




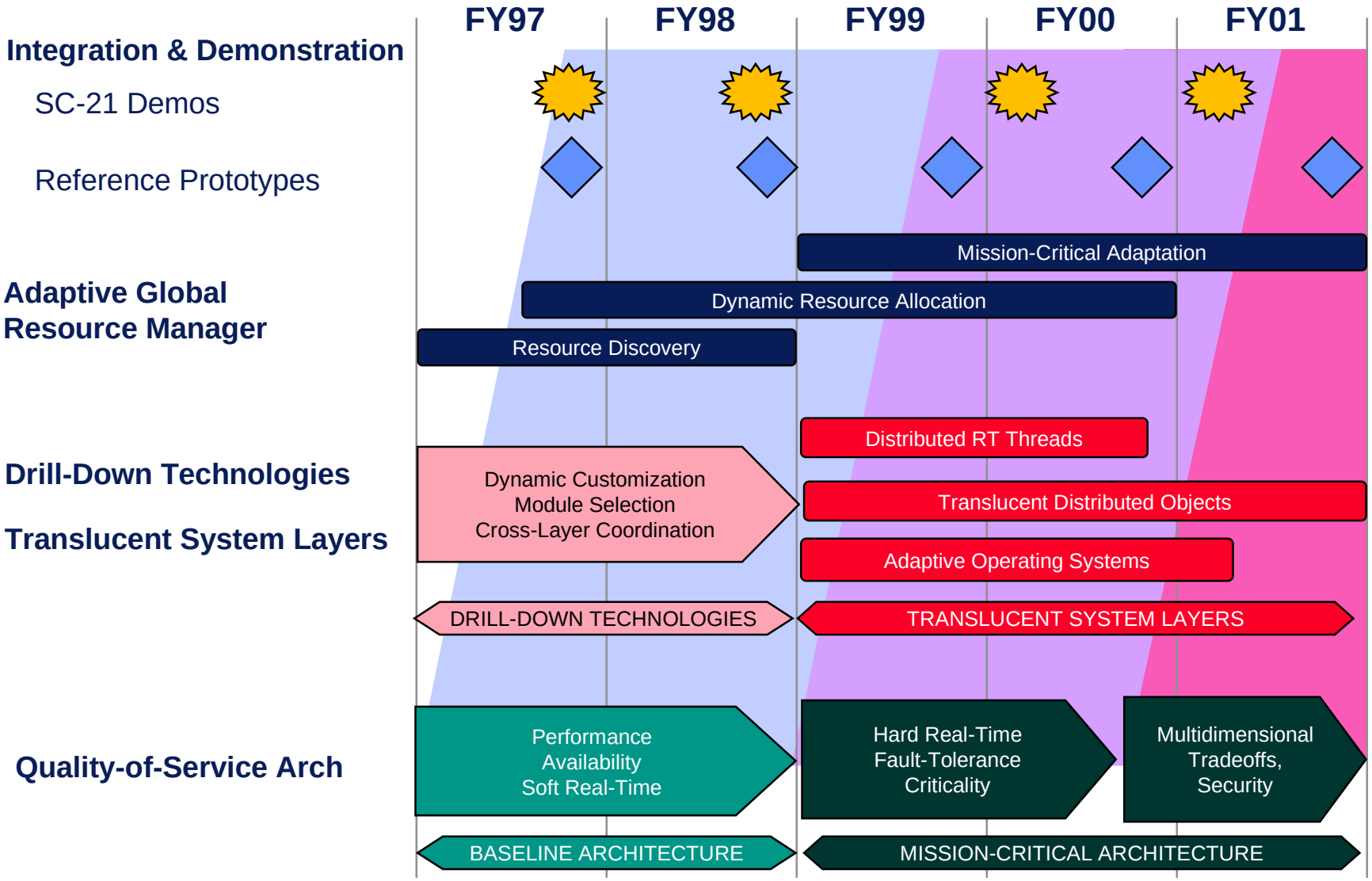
AdCon-21 Schedule Depends on Quorum



Quorum Integration Effort Mediates Transition



Quorum Road Map



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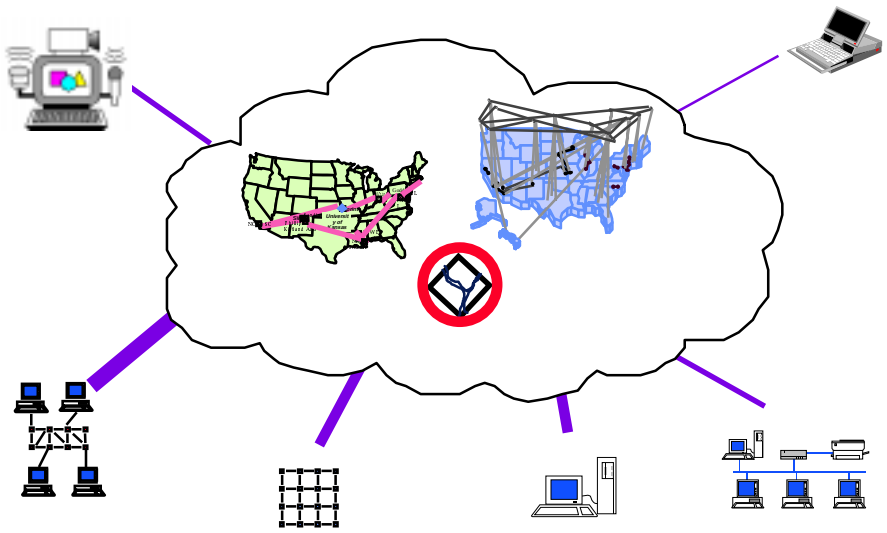

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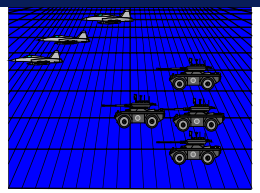

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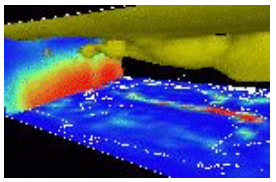

High Performance